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United States Patent [19][11] **Patent Number:** **6,167,304****Loos**[45] **Date of Patent:** **Dec. 26, 2000****[54] PULSE VARIABILITY IN ELECTRIC FIELD
MANIPULATION OF NERVOUS SYSTEMS**

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[76] Inventor: **Hendricus G. Loos**, 3019 Cresta Way,
Laguna Beach, Calif. 92651**FOREIGN PATENT DOCUMENTS**

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[21] Appl. No.: **09/336,369****[22] Filed:** **Jun. 17, 1999****OTHER PUBLICATIONS**

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Primary Examiner—William E. Kamm**[57] ABSTRACT**

Apparatus and method for manipulating the nervous system of a subject by applying to the skin a pulsing external electric field which, although too weak to cause classical nerve stimulation, modulates the normal spontaneous spiking patterns of certain kinds of afferent nerves. For certain pulse frequencies the electric field stimulation can excite in the nervous system resonances with observable physiological consequences. Pulse variability is introduced for the purpose of thwarting habituation of the nervous system to the repetitive stimulation, or to alleviate the need for precise tuning to a resonance frequency, or to control pathological oscillatory neural activities such as tremors or seizures. Pulse generators with stochastic and deterministic pulse variability are disclosed, and the output of an effective generator of the latter type is characterized.

11 Claims, 5 Drawing Sheets**Related U.S. Application Data**

[63] Continuation-in-part of application No. 09/118,505, Jul. 17, 1998, Pat. No. 6,081,744, which is a continuation-in-part of application No. 08/788,582, Jan. 24, 1997, Pat. No. 5,782,874, which is a continuation-in-part of application No. 08/447,394, May 23, 1995, abandoned, which is a continuation of application No. 08/068,748, May 28, 1993, abandoned.

[51] Int. Cl.⁷ **A61N 1/40****[52] U.S. Cl.** **607/2****[58] Field of Search** 607/2, 39, 46**[56] References Cited****U.S. PATENT DOCUMENTS**

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